

R is an alkyl group having at least one but not more than two non-halogenated substituents in the position  $\beta$  to silicon that are electronegative; and wherein said siloxane polymer contains silanol groups.

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### REMARKS

Claims 1 to 23 are presently pending in the application.

Claim 1 has been amended to more accurately characterize the siloxane polymers according to the present invention. Specifically, the claim now recites that the polymers are thermally and photo labile and undergo transformation to  $\text{SiO}_2$  rich films by the release of unsaturated hydrocarbons and protonated byproducts. Support for this amendment may be found in the specification at least at page 7, lines 3-7; page 7, line 27 to page 8, line 2; page 8, lines 10-15; and page 10, line 26 to page 11, line 4. Each of these sections describes the volatilization of labile  $\beta$ -substituted alkyl groups under heat or ultraviolet conditions to form a  $\text{SiO}_2$  rich film.

Claim 1 has also been amended to change the structural formula of the organosilane from  $\text{R}_n\text{SiX}_{4-n}$  to  $(\text{RCH}_2)_n\text{SiX}_{4-n}$ . The phrase "polymeric reaction product" has been replaced with "siloxane polymer". Furthermore, the phrase " $\beta$ -substituted alkyl group" has been replaced with "alkyl group substituted in the position  $\beta$  to silicon" for clarity.

Claims 2, 5 and 21 have been amended to change the functional groups from which the R substituent can be selected based on the new definition of the organosilane in claim 1. For example, "ethyl" has been changed to "methyl" and "propyl" to "ethyl". The compounds are identical to those in the original claims. In claim 2, the phrase " $\beta$ -substituted alkyl group" has been replaced with "alkyl group substituted in the position  $\beta$  to silicon", as in claim 1. Claims 5 and 21 have been amended to remove the phrase " $\beta$ -substituted" because it no longer applies to

a methyl substituent. Claim 3 has been rewritten in independent form incorporating the subject matter from claim 1 and claim 6 has been rewritten in independent form incorporating the subject matter from claims 1 and 5. Finally, claims 8-12, 14, 15 and 17 have been amended to change the phrase “polymeric reaction product”, which was previously found in independent claim 1, to “siloxane polymer”. These claims now correctly depend from claim 1. No new matter has been added by these amendments.

Finally, claims 22 and 23 are new but no new matter has been introduced by these additional claims. Claim 22 describes a polymer containing  $\beta$ -chloroethyl groups which was encompassed in the original claims and in the specification. Claim 23 is identical to claim 1, except that the substituents in the position  $\beta$  to silicon are specified as being non-halogenated.

Applicants acknowledge the Examiner’s withdrawal of the rejection based on Sommer, *et al.* The Examiner has indicated that claims 3, 4, 5, 6, 10, 20 and 21 are neither taught nor suggested by the prior art and would be allowable if rewritten in independent form. However, the Examiner has maintained her rejection of claims 1, 8, 11, 12, 14 and 16-18 under 35 U.S.C. § 103(a) as being anticipated by U.S. Patent No. 4,923,775 of Schank (“Schank”). The Examiner has also rejected claims 2, 5, 13 and 15 under 35 U.S.C. § 103(a) as being unpatentable over Schank. Finally, claims 1, 9, 11-13 and 15-19 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 3,666,830 of Alekna (“Alekna”). Applicants respectfully but strenuously traverse these rejections for the reasons set forth in the Amendment filed October 2, 2000 and for the additional reasons set forth below and request reconsideration and withdrawal of the rejections.

*Rejection Under §102(b) Based on Schank*

The Examiner has rejected claims 1, 8, 11, 12, 14 and 16-18 under 35 U.S.C. § 102(b) as being anticipated by Schank. The Examiner argues that, concerning the phrase “useful for preparing SiO<sub>2</sub> rich films”, a siloxane polymer need only to be able to prepare such films by any method. For example, the Examiner points to Example IV of Schank, allegedly forming a film which contains SiO<sub>2</sub>. The Examiner further argues that the claims do not require any type of thermal stability limitation for the polymers and further do not require any particular conditions under which the SiO<sub>2</sub> rich films are to be made. Additionally, the Examiner argues that Applicants have not shown that the siloxane in Schank is not useful for preparing such films, but merely have shown that Schank does not mention the hydrogen cyanide byproduct. Finally the Examiner argues that Applicants’ assumption that the siloxanes of Schank would not be useful in preparing any type of SiO<sub>2</sub> rich films appears to be an unsupported guess.

For a claim to be rejected as anticipated under 35 U.S.C. § 102(b), it must be shown that the prior art reference alone teaches or suggests all of the claimed elements. (M.P.E.P. §2131). In fact, “a claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference” (*Verdegal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987)).

For several reasons, these claims are not anticipated by Schank. By this amendment, independent claim 1 now includes the phrase “A photo and thermally labile siloxane polymer which undergoes transformation to SiO<sub>2</sub>-rich films by the release of unsaturated hydrocarbons and protonated byproducts...” This phrase was added to more accurately describe and characterize the siloxane polymers according to the present invention. The claim now

requires a “type of thermal stability limitation for the polymers”, that is, thermal lability, which the Examiner noted was not previously present. The cure mechanism for the siloxane polymers is now positively recited in the claim. In particular, the electron withdrawing substituents in the position  $\beta$  to silicon introduce photo and thermal lability and thus allow for the transformation to the silicon dioxide rich films by eliminating preferably ethylene and a protonated electron withdrawing group.

The phrase “useful for preparing  $\text{SiO}_2$  rich films” has been deleted. Instead, claim 1 now describes how the siloxane polymers undergo transformations to such films. Such a transformation is not found in Schank, which teaches a silicone overcoating for electrophotographic imaging members. The silicone overcoating comprises a polymerized silane with electron accepting groups on silicon. Schank does not teach or suggest alternative applications of the silicone materials and specifically does not teach or suggest a transformation to  $\text{SiO}_2$  rich films by the release of unsaturated hydrocarbons. In the present invention, the rearrangement and elimination resulting from photo and thermal lability are the crux of the ability of the polymers to form  $\text{SiO}_2$  films. Example IV of Schank, noted by the Examiner, does not teach that a film is formed by the release of unsaturated hydrocarbons and protonated byproducts. Even if such a film were formed, there is nothing in Schank to suggest a method for forming such a film as in the present claims.

As argued previously, if the siloxane polymers of Schank were used to prepare  $\text{SiO}_2$  rich films by, for example, heating the  $\beta$ -cyanoethyl-substituted siloxane of Schank (col. 6, line 32), hydrogen cyanide would be eliminated as a byproduct. The HCN evolution which the Examiner refers to as a straw man is rather an important indication of the difference between the polymers of the present invention and those of Schank. Schank specifically does not teach the

elimination required by the claim. In fact, for the performance of Schank's invention, the electronegative component must intrinsically stay intact, which is completely different from the groups in the polymers according to the present invention.

Finally, Schank specifically teaches that the cured silicone overcoating according to the invention does not degrade over an extended time period at low or elevated temperatures (column 3, lines 44-48). Therefore, not only does Schank not teach or suggest thermal *lability* of the silicone overcoatings, Schank actually teaches thermal *stability*.

Regarding claim 8, the Examiner comments that upon hydrolysis and condensation, the hydrolyzable Cl and OR groups in the silanes of Schank will form a comparable siloxane product, due to formation of an Si-O-Si network. Therefore, the Examiner argues, while Schank does not teach a trichlorosilane, the reaction product claimed appears to be inherently the same as the reaction product formed from a trialkoxysilane, and the product by process claim appears to be inherently met by Schank. However, in light of the amendment to independent claim 1, the polymer described by claim 8 must be able to form an SiO<sub>2</sub> rich film by releasing unsaturated hydrocarbons and protonated byproducts. Schank does not teach such a method for forming a film, and further does not teach that the siloxane, even if it were to be identical, is photo and thermally labile.

For all of these reasons, Schank does not set forth "each and every element of the claim" and Applicants respectfully request that the § 102(b) rejection based on Schank be reconsidered and withdrawn.

*Rejection Under §103(a) Based on Schank*

The Examiner has rejected claims 2, 5, 13 and 15 under 35 U.S.C. § 103(a) as being unpatentable over Schank. The Examiner argues, regarding claims 2 and 5, that although chlorine has been eliminated as a substituent from the claim, the formula on line 15 of column 6a of Schank shows that the X group attached to the ethylene group can be, alternatively, bromine, iodine or fluorine. This formula allegedly suggests  $\beta$ -iodoethylene,  $\beta$ -fluoroethylene, and  $\beta$ -bromoethylene, which are within the scope of claims 2 and 5. Additionally, the Examiner argues that the phrase “useful for making SiO<sub>2</sub> rich films” carries little weight in establishing an unobvious difference over Schank.

In order to establish *prima facie* obviousness, the Examiner must make all of the following showings: (1) there must be some suggestion or motivation to modify the reference as suggested by the Examiner (it is not sufficient to say that the cited reference can be modified without a teaching in the prior art to suggest the desirability of the modification); (2) there must also be a reasonable expectation of success; and (3) the reference must teach or suggest all limitations of the claims. The teaching or suggestion to combine or modify the applied art and the reasonable expectation of success must both be found in the prior art and not in Applicant’s specification. (M.P.E.P § 2143).

As discussed previously, the phrase “useful for making SiO<sub>2</sub> rich films” has been deleted and the claims now more accurately describe the siloxane polymers and their transformation to the SiO<sub>2</sub> rich films. Specifically, amended claims 2 and 5 now recite that the polymers obtained from organosilanes having particular substituents must be photo and thermally labile, and must undergo transformations to SiO<sub>2</sub> rich films by the release of

unsaturated hydrocarbons and protonated byproducts. Therefore, even if Schank teaches silanes containing iodoethyl, fluoroethyl, or bromoethyl substituents, Schank does not teach or suggest that: (1) such compounds produce photo and thermally labile siloxane polymers; or (2) such polymers would undergo the transformations required by the present claims in order to produce films according to the present invention. In fact, as discussed previously, Schank specifically teaches that the cured silicone overcoating according to the invention does not degrade over an extended time period at low or elevated temperatures (column 3, lines 44-48). The siloxanes of Schank are more thermally stable than the presently claimed siloxanes and there is nothing in Schank to suggest modifying the polymers to give thermal reactions at elevated temperatures. Further, as discussed above, Schank does not teach or suggest the elimination of hydrogen cyanide, which would be a byproduct resulting from the heating of such polymers as in the claimed invention.

In addition, the siloxanes of Schank are designed to require the presence of organic moieties on the polymers. Conversely, the present claims now recite that the SiO<sub>2</sub>-rich films according to the present invention are formed by eliminating the volatile organic groups. Such an elimination is also taught in the specification at least at page 10, line 26 to page 11, line 4. The siloxane polymers of the present invention were specially designed to have volatile organic groups which can be eliminated upon heating, resulting in SiO<sub>2</sub>-rich films which have application in the electronics industry. Not only were the siloxanes of Schank not designed for such a purpose, they were designed to retain the organic groups for use in electrophotographic coatings. Furthermore, even if one were motivated to utilize the electrophotographic imaging coatings of Schank in the microelectronics art of the present invention, there is no reasonable expectation of success.

Finally, as argued previously, the siloxane polymer in claim 15 is specifically obtained from copolymerization of the organosilane with an organotrichlorosilane. The siloxanes taught by Schank are prepared from the hydrolysis/condensation of *trialkoxysilanes* as shown in column 6, lines 12-19. There is nothing in Schank to suggest the use of trichlorosilanes in the synthesis of these materials. Additionally, there is nothing to teach or suggest that even if such materials were formed, they would have the properties required by the present claims.

For all these reasons, Schank fails to establish *prima facie* obviousness over the current claims. In light of these arguments, reconsideration and withdrawal of the Section 103 rejection of Applicants' claimed invention over Schank are respectfully requested.

*Rejection Under §103(a) Based on Alekna*

The Examiner has rejected claims 1, 9, 11-13, and 15-19 under 35 U.S.C. § 103(a) as being unpatentable over Alekna for reasons of record. The Examiner acknowledges that Alekna does not suggest the same future intended use of the siloxane as in the present application, but argues that the same siloxane polymer is suggested, as allegedly shown in column 2, line 65. The Examiner concludes that since the siloxane suggested by Alekna has the same structure as that claimed, any thermal properties associated with it will also be the same. Furthermore, the Examiner argues that since the  $\beta$ -chloroethyl siloxanes embraced by the claims are able to form SiO<sub>2</sub> rich films, the  $\beta$ -chloroethyl siloxane suggested by Alekna having the same formula will inherently be able to form SiO<sub>2</sub> rich films. The Examiner also argues that Applicants appear to be reading into the future intended use phrase in the claims some type of thermal stability limitation that is not present, and comments that a case of obviousness for a



composition does not require the same problem or recognition of the same advantages as the Applicants' invention.

In no way does Alekna teach or suggest a siloxane polymer according to Applicant's invention, that is, a photo and thermally labile siloxane polymer formed from the hydrolysis/condensation of an organosilane containing a  $\beta$ -substituted alkyl group which undergoes transformation to SiO<sub>2</sub>-rich thin films. Alekna describes two-component resin molding compounds in which the first component is an uncured silicone resin (containing at least 0.25% of silicon-bonded hydroxyl groups or lower alkoxy groups) and the second component is (i) a silane or siloxane containing silanol groups or alkoxy groups and (ii) a lead-based catalyst (column 1, lines 39-70). Alekna's two-component molding resins in no manner suggest Applicants' siloxane polymer or the intended use thereof.

Specifically, the amended claims now positively recite "some type of thermal stability limitation", that is, thermal lability of the siloxane polymer. In contrast, the siloxane resins taught by Alekna are important because they possess good thermal stability at elevated temperatures and are processed at high temperatures. For example, Alekna discloses that "the resin can be refluxed 2 to 3 hours at temperatures between 190 °C to 230 °C, to further improve the characteristics of the resin" (column 5, lines 55-57). These teachings clearly describe the desirability of a silicone molding resin that does not undergo significant reaction at elevated temperatures and as such do not motivate someone of ordinary skill in the art to prepare Applicants' claimed siloxane polymers, which have been specially designed to undergo reaction at elevated temperatures. As discussed in the Specification, pages 10-11, "When the  $\beta$ -substituted silsesquioxane polymers are reacted further, either by heating at moderate

temperature...the labile  $\beta$ -substituted alkyl groups are substantially volatilized and the silsesquioxane polymer is converted to a SiO<sub>2</sub>-rich ceramic material, suitable for preparing thin films or layers on electronic substrates". This is the crux of Applicants' invention and is now clearly recited in the claims.

There is nothing in Alekna to suggest the modification of the siloxane resins to give the desired and observed thermal reactivity in the present invention, that is, to be thermally unstable so as to evolve volatile materials upon heating. Alekna merely teaches siloxane units which can be present in the resin, not that such resins might be photo and thermally labile and could undergo transformation to SiO<sub>2</sub> rich films. Furthermore, even if the siloxanes of Alekna could form such films, Alekna does not teach or suggest the cure mechanism encompassed by the claims. As such, Alekna fails to establish *prima facie* obviousness of Applicant's claimed invention.

For these reasons, reconsideration and withdrawal of the Section 103 rejection of Applicants' claimed invention over Alekna are respectfully requested.

In view of the foregoing amendments and remarks, it is respectfully submitted that the claims are patentable, distinct from the prior art of record, and in condition for allowance. A Notice of Allowance is respectfully requested.

Respectfully submitted,

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Enclosure: Appendix: Marked-Up Version of Claims 1-3, 5, 6, 8-12, 14, 15, 17 and 21

## Appendix: Marked Up Version of Claims 1-3, 5, 6, 8-12, 14, 15, 17 and 21

1. (Amended) A photo and thermally labile siloxane polymer [useful for preparing] which undergoes transformation to SiO<sub>2</sub>-rich films by the release of unsaturated hydrocarbons and protonated byproducts, [which comprises the polymeric reaction product] obtained from the hydrolysis and condensation polymerization of an organosilane containing [a  $\beta$ -substituted] an alkyl group substituted in the position  $\beta$  to silicon, the organosilane having the general formula:



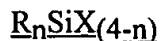
where  $n$  is 1 or 2;

$X$  is a halogen selected from the group consisting of chlorine, bromine, fluorine, and iodine; or an alkoxy selected from the group consisting of methoxy, ethoxy and propoxy substituents; and

$R$  is an alkyl group having at least one but not more than two [ $\beta$ -] substituents in the position  $\beta$  to silicon that are electronegative; and wherein said [polymeric reaction product] siloxane polymer contains silanol groups.

2. (Amended) The siloxane polymer of claim 1 wherein, in the general formula for the organosilane,  $R$  is [an ethyl] a methyl group or [propyl] ethyl group having at least one but not more than two [ $\beta$ -]substituents in the position  $\beta$  to silicon selected from the group consisting of bromine, fluorine, iodine, hydroxy, methoxy, ethoxy, and acetoxy.

3. (Amended) ) A photo and thermally labile siloxane polymer which undergoes transformation to SiO<sub>2</sub>-rich films by the release of unsaturated hydrocarbons and protonated byproducts, obtained from the hydrolysis and condensation polymerization of an organosilane containing a  $\beta$ -substituted alkyl group, the organosilane having the general formula: ✓



where  $n$  is 1 or 2;

X is a halogen selected from the group consisting of chlorine, bromine, fluorine, and iodine; or an alkoxy selected from the group consisting of methoxy, ethoxy and propoxy substituents; and

R is an alkyl group having at least one but not more than two  $\beta$ -substituents that are electronegative and [The siloxane polymer of claim 1 which further comprises] at least one but not more than two  $\alpha$ -substituents on the  $\beta$ -substituted alkyl group, the  $\alpha$ -substituent being selected from the group consisting of chlorine, bromine, fluorine, iodine, hydroxy, methoxy, ethoxy, and acetoxy;  
and wherein said siloxane contains silanol groups.

5. (Amended) The siloxane polymer of claim 1 wherein, in the general formula for the organosilane, n is 1;

X is a halogen selected from the group consisting of chlorine and bromine or an alkoxy selected from the group consisting of methoxy and ethoxy substituents; and

R is [an ethyl] a methyl group having at least one but not more than two [ $\beta$ -] substituents selected from the group consisting of bromine, fluorine, hydroxy, methoxy, and acetoxy.

6. (Amended) A photo and thermally labile siloxane polymer which undergoes transformation to SiO<sub>2</sub>-rich films by the release of unsaturated hydrocarbons and protonated byproducts, obtained from the hydrolysis and condensation polymerization of an organosilane containing a  $\beta$ -substituted alkyl group, the organosilane having the general formula:



where n is 1;

X is a halogen selected from the group consisting of chlorine and bromine, or an alkoxy selected from the group consisting of methoxy and ethoxy substituents; and

R is an ethyl group having at least one but not more than two  $\beta$ -substituents selected from the group consisting of bromine, fluorine, methoxy, and acetoxy and [The siloxane polymer of claim 5 which further comprises] at least one but not more than two  $\alpha$ -substituents on

the  $\beta$ -substituted ethyl group, the  $\alpha$ -substituent being selected from the group consisting of chlorine, bromine, fluorine, hydroxy, methoxy, and acetoxy;  
and wherein said siloxane polymer contains silanol groups.

8. (Amended) The siloxane polymer of claim 1 wherein the [polymeric reaction product] siloxane polymer is obtained from the hydrolysis and condensation polymerization of a  $\beta$ -substituted ethyltrichlorosilane, wherein the  $\beta$ -substituent is non-halogenated.

9. (Amended) The siloxane polymer of claim 1 wherein the [polymeric reaction product] siloxane polymer contains at least about five up to about 75 silanol groups per 100 silicon atoms.

10. (Amended) The siloxane polymer of claim 1 wherein the [polymeric reaction product] siloxane polymer contains about 20 to about 50 silanol groups per 100 silicon atoms.

11. (Amended) The siloxane polymer of claim 1 wherein the [polymeric reaction product] siloxane polymer is obtained from homopolymerization of the organosilane.

12. (Amended) The siloxane polymer of claim 1 wherein the [polymeric reaction product] siloxane polymer is obtained from copolymerization of the organosilane with an alkoxysilane.

14. (Amended) The siloxane polymer of claim 1 which further comprises a [polymeric reaction product] siloxane polymer obtained from copolymerization of the organosilane with a hydride-functional silane selected from the group consisting of trichlorosilane and triethoxysilane.

15. (Amended) The siloxane polymer of claim 1 which further comprises a [polymeric reaction product] siloxane polymer obtained from copolymerization of the organosilane with an organotrichlorosilane selected from the group consisting of ethyltrichlorosilane, methyltrichlorosilane and phenyltrichlorosilane.

17. (Amended) The siloxane polymer of claim 16 wherein the [polymeric reaction product] siloxane polymer is extracted from the aqueous medium with an organic solvent.

21. (Amended) The siloxane polymer of claim 1 wherein, in the general formula for the organosilane, R is [an ethyl] a methyl group having at least one but not more than two [β-] acetoxy substituents.